

WHAT IS CLAIMED IS:

1                    1.        A device for steering an electromagnetic beam, the device comprising:  
2                    a reflective element;  
3                    a polarizer configured to transmit light of a specified polarization and to  
4 reflect light having other than the specified polarization;  
5                    a relay focusing element disposed to provide optical paths for the  
6 electromagnetic beam from a first spot position to a second spot position spatially displaced  
7 from the first spot position such that the optical paths encounter the reflective element and the  
8 polarizer; and  
9                    a modulation element configured for selectively transforming a polarization of  
10 the electromagnetic beam to include a component of the specified polarization at a spatially  
11 localized position along the optical paths.

1                    2.        The device recited in claim 1 wherein at least one of the reflective  
2 element and polarizer is inclined with respect to an initial direction of propagation of the  
3 electromagnetic beam.

1                    3.        The device recited in claim 1 wherein the relay focusing element  
2 comprises a lens.

1                    4.        The device recited in claim 3 wherein the lens comprises a gradient-  
2 index lens.

1                    5.        The device recited in claim 3 wherein the lens comprises a lens array.

1                    6.        The device recited in claim 1 wherein the reflective element and  
2 polarizer are substantially flat.

1                    7.        The device recited in claim 1 wherein the relay focusing element is  
2 disposed such that the electromagnetic beam is substantially focused at each encounter with  
3 the polarizer.

1                    8.        The device recited in claim 1 wherein the modulation element  
2 comprises a pixellated spatial light modulator.

1                    9.        The device recited in claim 8 wherein the pixellated spatial light  
2 modulator comprises a transmissive spatial light modulator.

1                    10.       The device recited in claim 8 wherein the pixellated spatial light  
2 modulator comprises a reflective spatial light modulator.

1                    11.       The device recited in claim 1 wherein the modulation element is  
2 configured to transform the polarization of the electromagnetic beam to include the  
3 component of the specified polarization and to include a component orthogonal to the  
4 specified polarization for each of a plurality of encounters of the electromagnetic beam with  
5 the modulation element.

1                    12.       The device recited in claim 1 wherein the second spot position is  
2 displaced in two dimensions from the first spot position within a plane orthogonal to an initial  
3 direction of the electromagnetic beam.

1                    13.       The device recited in claim 1 further comprising:  
2                    a second reflective element;  
3                    a second polarizer configured to transmit light of the specified polarization  
4 and to reflect light having other than the specified polarization;  
5                    a second relay focusing element disposed to provide second optical paths for  
6 the electromagnetic beam from the second spot position to a third spot position spatially  
7 displaced from the second spot position in a direction nonparallel to a displacement of the  
8 second spot position from the first spot position such that the second optical paths encounter  
9 the second reflective element and second polarizer; and  
10                   a second modulation element configured for selectively transforming a  
11 polarization of the electromagnetic beam to include a component of the specified polarization  
12 at a spatially localized position along the second optical paths.

1                    14.       A device for steering an electromagnetic beam, the device comprising:  
2                    a focusing element disposed to focus the electromagnetic beam onto a first  
3 spot position;  
4                    an optical train configured to translate the first spot position spatially to a  
5 second spot position nonmechanically by routing the electromagnetic beam through the  
6 optical train; and

a collimation element disposed to collimate the electromagnetic beam  
emanating from the second spot position.

15. The device recited in claim 14 wherein the focusing element comprises  
a lens.

16. The device recited in claim 14 wherein the collimation element  
comprises a lens.

17. The device recited in claim 16 wherein the lens has an  $f/\#$  less than  
two.

18. The device recited in claim 14 wherein the optical train comprises:  
a plurality of reflective elements; and  
a relay focusing element disposed to provide optical paths for the  
electromagnetic beam from the first spot position to the second spot position such that the  
optical paths encounter each of the plurality of reflective elements.

19. The device recited in claim 18 wherein each of the plurality of  
reflective elements is substantially flat.

20. The device recited in claim 18 wherein the relay focusing element is  
disposed such that the electromagnetic beam is substantially focused at each encounter with  
the plurality of reflective elements.

21. The device recited in claim 18 wherein one of the reflective elements  
comprises a polarizer disposed to transmit light of a specified polarization, the optical train  
further comprising a modulation element configured for selectively transforming a  
polarization of the electromagnetic beam to include a component of the specified polarization  
at a spatially localized position.

22. The device recited in claim 21 wherein the modulation element  
comprises a pixellated spatial light modulator.

23. The device recited in claim 22 wherein the pixellated spatial light  
modulator comprises a transmissive spatial light modulator.

1                   24.     The device recited in claim 22 wherein the pixellated spatial light  
2 modulator comprises a reflective spatial light modulator.

1                   25.     The device recited in claim 21 wherein the modulation element is  
2 configured to transform the polarization of the electromagnetic beam to include the  
3 component of the specified polarization and to include a component orthogonal to the  
4 specified polarization for each of a plurality of encounters of the electromagnetic beam with  
5 the modulation element.

1                   26.     The device recited in claim 18 wherein the relay focusing element  
2 comprises a lens.

1                   27.     The device recited in claim 26 wherein the lens comprises a gradient-  
2 index lens.

1                   28.     The device recited in claim 26 wherein the lens comprises a lens array.

1                   29.     The device recited in claim 18 wherein the relay focusing element  
2 comprises a plurality of relay focusing elements, a first of the relay focusing elements being  
3 disposed to provide optical paths for the electromagnetic beam from the first spot position to  
4 an intermediate spot position and a second of the relay focusing elements being disposed to  
5 provide optical paths from the intermediate spot position to the second spot position.

1                   30.     The device recited in claim 29 wherein:  
2                   the paths for the electromagnetic beam from the first spot position to the  
3 intermediate spot position encounter each of the first subset of the plurality of reflective  
4 elements; and  
5                   the paths for the electromagnetic beam from the intermediate spot position to  
6 the second spot position encounter each of the second subset of the plurality of reflective  
7 elements.

1                   31.     The device recited in claim 14 further comprising a supplementary  
2 beam-steering assembly configured to steer the electromagnetic beam by a supplementary  
3 beamsteering angle that is smaller than a least beamsteering angular discrimination provided  
4 by the combination of the focusing element, optical train, and collimation element.

1                   32.     The device recited in claim 31 wherein the supplementary beam-  
2 steering assembly is disposed to steer the electromagnetic beam by the supplementary  
3 beamsteering angle prior to the electromagnetic beam encountering the focusing element.

1                   33.     The device recited in claim 14 wherein:  
2                   the focusing element comprises a plurality of focusing elements respectively  
3 disposed to focus the electromagnetic beam onto respective first spot positions;  
4                   the optical train comprises a plurality of optical trains respectively configured  
5 to translate a respective one of the first spot positions spatially to a respective second spot  
6 position nonmechanically by routing the electromagnetic beam through the respective optical  
7 train; and  
8                   the collimation element comprises a plurality of collimation elements  
9 respectively disposed to collimate the electromagnetic beam emanating from the respective  
10 second spot positions.

1                   34.     A device for steering an electromagnetic beam, the device comprising:  
2                   a focusing lens disposed to focus the electromagnetic beam onto a first spot  
3 position;  
4                   a mirror;  
5                   a reflective polarizer configured to transmit light of a specified polarization;  
6                   a relay lens disposed to provide optical paths for the electromagnetic beam  
7 from the first spot position to a second spot position such that the optical paths encounter the  
8 mirror and the reflective polarizer; and  
9                   a spatial light modulator configured for selectively transforming a polarization  
10 of the electromagnetic beam to include a component of the specified polarization at the  
11 second spot position.

1                   35.     The device recited in claim 34 wherein at least one of the mirror and  
2 reflective polarizer is inclined with respect to an optic axis of the focusing lens.

1                   36.     The device recited in claim 34 wherein the reflective polarizer is  
2 substantially flat.

1                   37.     The device recited in claim 34 wherein the mirror is substantially flat.

1                   38.     The device recited in claim 34 wherein the relay lens is disposed such  
2     that the electromagnetic beam is substantially focused at each encounter with the reflective  
3     polarizer.

1                   39.     The device recited in claim 34 wherein the spatial light modulator  
2     comprises a transmissive spatial light modulator.

1                   40.     The device recited in claim 34 wherein the spatial light modulator  
2     comprises a reflective spatial light modulator.

1                   41.     The device recited in claim 34 wherein:  
2                   the mirror comprises a plurality of mirrors;  
3                   the reflective polarizer comprises a plurality of reflective polarizers;  
4                   the relay lens comprises a plurality of relay lenses, a first of such relay lenses  
5     being disposed to provide optical paths for the electromagnetic beam from the first spot  
6     position to an intermediate spot position that encounter a first of such mirrors and a first of  
7     such reflective polarizers and a second of such relay lenses being disposed to provide optical  
8     paths for the electromagnetic beam from the intermediate spot position to the second spot  
9     position that encounter a second of such mirrors and a second of such reflective polarizers;  
10    and  
11                  the spatial light modulator comprises a plurality of spatial light modulators, a  
12    first of such spatial light modulators being configured for selectively transforming the  
13    polarization of the electromagnetic beam to include the component of the specified  
14    polarization at the intermediate spot position and a second of such spatial light modulations  
15    being configured for selectively transforming the polarization of the electromagnetic beam to  
16    include the component of the specified polarization at the second spot position.

1                   42.     The device recited in claim 34 further comprising a collimation lens  
2     disposed to collimate the electromagnetic beam emanating from the second spot position.

1                   43.     A method for steering an electromagnetic beam, the method  
2     comprising:  
3                   focusing the electromagnetic beam onto a first spot position;  
4                   routing the electromagnetic beam through an optical train to translate the first  
5     spot position spatially to a second spot position nonmechanically; and

6 collimating the electromagnetic beam after the electromagnetic beam  
7 emanates from the second spot position.

1 44. The method recited in claim 43 wherein routing the electromagnetic  
2 beam through the optical train comprises progressively focusing the electromagnetic beam  
3 onto spatially displaced intermediate spot positions.

1 45. The method recited in claim 44 wherein routing the electromagnetic  
2 beam through the optical train further comprises reflecting the electromagnetic beam from  
3 each of the intermediate spot positions to a subsequent spot position.

1 46. The method recited in claim 44 further comprising:  
2 selectively transforming a polarization of the electromagnetic beam to include  
3 a component of a specified polarization at a spatially localized position; and  
4 emanating the component of the specified polarization from the second spot  
5 position.

1 47. The method recited in claim 44 further comprising:  
2 transforming a polarization of the electromagnetic beam to include a  
3 component of a specified polarization and a component orthogonal to the specified  
4 polarization at each of the intermediate spot positions;  
5 reflecting the component orthogonal to the specified polarization from each of  
6 the intermediate spot positions; and  
7 emanating the component of the specified polarization from the intermediate  
8 spot positions.

1 48. The method recited in claim 43 wherein the second spot position is  
2 displaced in two dimensions from the first spot position within a plane orthogonal to an initial  
3 direction of the electromagnetic beam.

1 49. The method recited in claim 43 wherein routing the electromagnetic  
2 beam through the optical train comprises:  
3 routing the electromagnetic beam to translate the first spot position to an  
4 intermediate spot position having a displacement component relative to the first spot position  
5 orthogonal to an initial direction of the electromagnetic beam; and

6                   thereafter, routing the electromagnetic beam to translate the intermediate spot  
7 position to the second spot position, wherein the second spot position has a displacement  
8 component relative to the intermediate spot position orthogonal to the initial direction of the  
9 electromagnetic beam and orthogonal to the displacement component of the intermediate spot  
10 position relative to the first spot position.

1                   50.     The method recited in claim 43 further comprising steering the  
2 electromagnetic beam by a supplementary beamsteering angle that is smaller than a least  
3 beamsteering angular discrimination provided by the combination of focusing the  
4 electromagnetic beam, routing the electromagnetic beam, and collimating the electromagnetic  
5 beam.

1                   51.     A device for steering an electromagnetic beam, the device comprising:  
2                   means for focusing the electromagnetic beam onto a first spot position;  
3                   means for routing the electromagnetic beam to translate the first spot position  
4 spatially to a second spot position nonmechanically; and  
5                   means for collimating the electromagnetic beam after the electromagnetic  
6 beam emanates from the second spot position.

1                   52.     The device recited in claim 51 wherein the means for routing the  
2 electromagnetic beam comprises means for progressively focusing the electromagnetic beam  
3 onto spatially displaced intermediate spot positions.

1                   53.     The device recited in claim 52 wherein the means for routing the  
2 electromagnetic beam further comprises means for reflecting the electromagnetic beam from  
3 each of the intermediate spot positions to a subsequent spot position.

1                   54.     The device recited in claim 52 further comprising:  
2                   means for selectively transforming a polarization of the electromagnetic beam  
3 to include a component of a specified polarization at a spatially localized position; and  
4                   means for emanating the component of the specified polarization from the  
5 second spot position.

1                   55.     The device recited in claim 52 further comprising:



means for transforming a polarization of the electromagnetic beam to include a component of a specified polarization and a component orthogonal to the specified polarization at each of the intermediate spot positions;

means for reflecting the component orthogonal to the specified polarization from each of the intermediate spot positions; and

means for emanating the component of the specified polarization from the intermediate spot positions.

56. The device recited in claim 51 further comprising means for steering the electromagnetic beam by a supplementary beamsteering angle that is smaller than a least beamsteering angular discrimination provided by the combination of the means for focusing, the means for routing, and the means for collimating.